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PATENT

#22 Appeal Brief T. Yang 8-30-03

BEFORE THE BOARD OF PATENT APPEALS AND INTERFERENCES

In re Application of: Ghaemmaghami et al.

Serial No.: 09/497,320

Filed: February 3, 2000

Group Art Unit: 2815

Before the Examiner: Jose R. Diaz

Title: METHOD AND SYSTEM FOR PROVIDING HALO IMPLANT TO A SEMICONDUCTOR DEVICE WITH MINIMAL IMPACT TO THE JUNCTION CAPACITANCE

APPEAL BRIEF

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Commissioner for Patents
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I. REAL PARTY IN INTEREST

The real party in interest is Advanced Micro Devices, Inc., which is the assignee of the entire right, title and interest in the above-identified patent application.

CERTIFICATION UNDER 37 C.F.R. § 1.8

I hereby certify that this correspondence is being deposited with the United States Postal Service with sufficient postage as first class mail in an envelope addressed to Mail Stop AF, Commissioner for Patents, P.O. Box 1450, Alexandria, Virginia 22313-1450, on August 8, 2003.

Serena Beller
Signature

Serena Beller
(Printed name of person certifying)

II. RELATED APPEALS AND INTERFERENCES

There are no other appeals or interferences known to Appellants, Appellants' legal representative or assignee which will directly affect or be directly affected by or have a bearing on the Board's decision in the pending appeal.

III. STATUS OF CLAIMS

Claims 1, 4, 5, 7, 8, 11, 12 and 14 are pending in the Application. Claims 2-3, 6, 9-10 and 13 were canceled. Claims 1, 4, 5, 7, 8, 11, 12 and 14 stand rejected.

IV. STATUS OF AMENDMENTS

The Appellants' response to the Office Action, having a mailing date of November 19, 2002, has been considered, but the Examiner indicated that it did not place claims 1, 4, 5, 7, 8, 11, 12 and 14 in condition for allowance because the Appellants' arguments were deemed unpersuasive.

V. SUMMARY OF INVENTION

A halo implant is typically utilized to implant dopant on a semiconductor device. Specification, Page 1, Line 6. In-line lithography or DUV (deep ultra violet) photoresist is typically utilized to mask the halo implant process. Specification, Page 1, Lines 6-8. Typically, the same mask (lightly doped drain) (LDD) is utilized for the halo implant, since the halo implant takes place after the LDD implant. Specification, Page 1, Lines 8-9. Due to the chemistry of the photoresist, an implant shadowing problem may occur which adversely affects yield and performance of the devices as manufacturing processes move toward smaller geometries. Specification, Page 1, Lines 9-12.

The first problem is that the photoresist thickness in the area of implant is of a thickness such that an implant delivered at a 45° angle can result in an asymmetric and leaky transistor. Specification, Page 1, Lines 13-15. A second problem is the thickness of the photoresist related to the trench oxidation region of the device. Specification, Page 1, Lines 15-16. If a thick photoresist (0.55μm or greater) is placed over the trench oxidation, oftentimes the photoresist will fall and cover areas that are to be implanted. Specification, Page 1, Lines 16-18. Even if the photoresist stands erect at the smaller process technologies, the halo implant will not reach the targeted areas. Specification, Page 1, Lines 18-19. In addition, the conventional processes do not typically account for the need for selective doping of the source/drain area. Specification, Page 1, Lines 19-21.

Accordingly, what is needed is a system and method for overcoming the above-identified problems at smaller process geometrics. Specification, Page 2, Lines 1-2.

The problems outlined above may at least in part be solved in some embodiments by providing a thin photoresist layer to the semiconductor device. Specification, Page 2, Lines 7-8. A halo implant may be provided to the appropriate area of the semiconductor device. Specification, Page 2, Lines 8-9.

Accordingly, a photoresist that is capable of a thinner profile is utilized. Specification, Page 2, Lines 10-11. This may allow one to lower the photoresist thickness to a proposed 1000Å (in the field) or lower if the process allows. Specification, Page 2, Lines 11-13. With this photoresist thickness, taking into account other height variables, the source and drain regions may be opened only as needed. Specification, Page 2, Lines 13-14.

At a 45° angle, the implant may be delivered to all transistors in the circuit in the targeted areas as well as getting only a large amount of the dose (up to ¾ of the

dose) to the transistor edge which sits on the trench edge. Specification, Page 2, Lines 15-17. This may also minimize the counter doping of the source/drain with the opposite species as is required by the definition of the halo process. Specification, Page 2, Lines 17-18.

VI. ISSUE

Are claims 1, 4-5, 7-8, 11-12 and 14 properly rejected under 35 U.S.C. §103(a) as being unpatentable over Hori et al. (U.S. Patent No. 5,320,974) (hereinafter "Hori") in view of Appellants' Specification?

VII. GROUPING OF CLAIMS

Claims 1, 4-5, 8 and 11-12 form a first group.

Claims 7 and 14 form a second group.

The reasons for these groupings are set forth in Appellants' arguments in Section VIII.

VIII. ARGUMENT

A. The Examiner Has Not Presented a *Prima Facie* Case of Obviousness

The Examiner has rejected claims 1, 4-5, 7-8, 11-12 and 14 under 35 U.S.C. §103(a) as being unpatenable over Hori in view of Appellants' Specification. Paper no. 19, page 3.

A *prima facie* showing of obviousness requires the Examiner to establish, *inter alia*, that the prior art references teach or suggest, either alone or in combination, all of the limitations of the claimed invention, and the Examiner must provide a motivation or suggestion to combine or modify the prior art reference to

make the claimed inventions. M.P.E.P. §2142. The motivation or suggestion to combine references must come from one of three possible sources: the nature of the problem to be solved, the teaching of the prior art and the knowledge of persons of ordinary skill in the art. *In re Rouffet*, 47 U.S.P.Q.2d. 1453,1458 (Fed. Cir. 1998). The showings must be clear and particular. *In re* Lee, 277 F.3d 1338, 1343, 61 U.S.P.Q.2d 1430, 1433-34 (Fed. Cir. 2002); *In re Kotzab*, 217 F.3d 1365, 1370, 55 U.S.P.Q.2d 1313, 1317 (Fed. Cir. 2000); *In re Dembiczak*, 50 U.S.P.Q.2d. 1614, 1617 (Fed. Cir. 1999). Broad conclusory statements regarding the teaching of multiple references, standing alone, are not evidence. *Id.*

With regard to the obviousness rejections, the Examiner states:

> Hori et al. teach a method for providing a halo implant in a semiconductor device (see cols 1-18) comprising the steps of: providing a thin mask layer (MASK) to the semiconductor device, wherein the thin mask layer (MASK) is a thickness less than a gate height (N+ POLY-SI GATE) and covers a substantial amount of an active area (DRAIN) comprising a source region and a drain region of the semiconductor device; and providing the halo implant (B+) (see Fig. 3). However, Hori et al. *fails to teach mask comprising of a DUV photoresist*. Applicant acknowledges that is well known in the art to use DUV photoresist to implant the halo region (see page 1, lines 6-12). Therefore, it would have been obvious to one having ordinary skill in the art at the same time the invention was made to modify Hori et al. to include halo mask comprised of a DUV photoresist. The ordinary artisan would have been *motivated to modify Hori et al.* in the manner described above *for at least the purpose of protecting the desired surface of the substrate from the implantation beam.* Paper No. 16, page 4.
>
> The reference Hori et al. provides the general teaching of a halo process in which a thin mask layer (MASK) is used to implant halo regions in a substrate (see Fig. 3). However, *Hori et al. does not teach the claimed invention of using a DUV photoresist as a mask.* Applicant acknowledges that the DUV photoresist material is typically used as a mask in such conventional halo implant process (see page 1, lines 6-9 of Applicants' Specification). As further evidence, the

> examiner cites pages 321-323 of Wolf et al. in which it is made clear that many materials including photoresist are conventionally used for masking purposes (see last paragraph of page 321 of Wolf et al.) Applicant should note that the use of conventional materials to perform their known functions in a conventional process is obvious. In re Rainer 134 U.S.P.Q. 343 (CCPA 1962).
>
> With regards to the motivation, the *motivation for modifying Hori* et al. references can be found on page 4, line 5 of Applicant's Specification (e.g. to "*consistently implant the intended areas*"); and on page 321, last paragraph of the required evidence of Wolf et al. (e.g. "[T]to *restrict the ionic species from being implanted into unwanted substrate regions*"). Thus, each reference supports the motivation indicated by the examiner in which it is obvious to use a photoresist mask for protecting the desired surfaces of the substrate. Therefore, the examiner has presented a *prima facie* case of obviousness for rejecting claims 1, 4-5, 7-8, 11-12 and 14, since the references Hori et al. and the conventional method taught by Applicant are from the same field of endeavor, teach all of the limitations of the claimed invention and a motivation was provided to combine the references. As such, the rejection is considered to be proper. Paper No. 19, pages 4-5.

Thus, the Examiner's motivation for modifying Hori to use a "mask comprising a DUV photoresist" is "*for at least the purpose of protecting the desired surface of the substrate from the implantation beam.*" Paper no. 16, page 4. **Appellants note that claims 1 and 8 do not state "a mask comprising a DUV photoresist" but instead state a "*thin photoresist layer as a mask.*"** Hence, Appellants assume that the Examiner argues that the above-cited motivation establishes that Hori can be modified to have a *thin photoresist layer as a mask.* Further, the Examiner's motivation for modifying Hori to use a "*thin photoresist layer as a mask,*" as recited in claims 1 and 8, is to "*consistently implant the intended areas*" or "*to restrict the ionic species from being implanted into unwanted substrate regions.*" Paper No. 19, pages 4-5.

1. The Examiner's Use of the Reference Wolf et al.

Appellants note that the Examiner has cited the reference Wolf et al. but did not specifically state that claims 1, 4-5, 7-8, 11-12 and 14 were rejected over Hori in view of Wolf et al. If the Examiner is rejecting claims 1, 4-5, 7-8, 11-12 and 14 over Hori in view of Wolf et al., Appellants respectfully assert that the Examiner has not provided any **objective evidence** for combining Hori with Wolf. *In re Lee*, 61 U.S.P.Q.2d 1430, 1434 (Fed. Cir. 2002).

Further, as stated above, the Examiner states:

> As further evidence, the examiner cites pages 321-323 of Wolf et al. in which it is made clear that many materials including *photoresist are conventionally* used for *masking purposes* (see last paragraph of page 321 of Wolf et al.) Applicant should note that *the use of conventional materials to perform their known functions in a conventional process is obvious*. In re Raner 134 USPQ 343 (CCPA 1962). Paper no. 19, page 5.

The Examiner asserts that Wolf et al. teach that many materials including photoresist are *conventionally* used for masking purposes. Paper no. 19, page 5. However, Wolf et al. do not state that photoresist are *conventionally* used for masking purposes. That is, Wolf et al. do not state that photoresist are generally used for masking purposes. Instead, Wolf et al. state:

> *To restrict the ionic species from being implanted into unwanted substrate regions*, an *appropriate mask layer needs to be present on the wafer surface.* Many materials are use for such masking purposes in IC fabrication including photoresist, SiO_2, Si_3N_4, polysilicon, metal films, and polymide. Page 321.

Thus, Wolf et al. teach that photoresist may be used for masking purposes for the specific application of *restricting the ionic species from being implanted into*

unwanted substrate regions. Hence, Wolf et al. do not teach that photoresist is *conventionally* used for all types of masking purposes as alleged by the Examiner. Instead, Wolf et al. teach that a photoresist may be used for masking purposes for the specific purpose of *restricting the ionic species from being implanted into unwanted substrate regions*. Hence, in order to combine Hori and Wolf et al., the Examiner must show a motivation to modify Hori to restrict the ionic species from being implanted into unwanted substrate regions. See M.P.E.P. §2142. The Examiner has not shown why one of ordinary skill in the art would modify Hori to *restrict the ionic species from being implanted into unwanted substrate regions from either the nature of the problem to be solved, the teaching of the prior art or the knowledge of persons of ordinary skill in the art*. *In re Rouffet*, 47 U.S.P.Q.2d. 1453,1458 (Fed. Cir. 1998). Further, the Examiner must submit **objective evidence** and not rely on his own subjective opinion in support of modifying Hori to *restrict the ionic species from being implanted into unwanted substrate regions*. *In re Lee*, 61 U.S.P.Q.2d 1430, 1434 (Fed. Cir. 2002).

Further, the Examiner relies upon *In re Rainer*, 134 U.S.P.Q. 334 (C.C.P.A. 1962) for the assertion that the use of conventional materials to perform their known functions in a conventional process is obvious. The Examiner has misapplied the reasoning of *In re Rainer*. Instead, *In re Rainer* stands for the proposition that merely reciting the use of a "conventional material" in a claim to a process to perform its conventional function will not render patentable an otherwise unpatentable claim. *In re Rainer*, 134 U.S.P.Q. 334, 348 (C.C.P.A. 1962). That is, *In re Rainer* stands for the proposition that if a claim is unpatenable that by adding a limitation to a conventional material will not make the unpatenable claim patentable. *Id.* *In re Rainer* does not stand for the proposition that the use of conventional materials to perform their known functions in a conventional process is obvious. Thus, *In re Rainer* does not support the Examiner's assertion.

Further, Appellants note that *In re Rainer*, upon which the Examiner relies, precedes *Graham vs. John Deere Co.*, 383 U.S. 1, 148 U.S.P.Q. 459 (1966). Accordingly, the holdings of *Graham* may overrule the holdings of *In re Rainer*.

2. The Examiner Has Not Provided Any Motivation For Combining Hori and Appellants' Specification

There is no motivation to modify Hori by Appellants' Specification. As stated above, the Examiner's motivation for modifying Hori to *use a thin photoresist layer*, as recited in claims 1 and 8, is to *protect the desired surface of the substrate from the implantation beam*. Further, as stated above, the Examiner's motivation for modifying Hori to *use a thin photoresist layer* is to *consistently implant the intended areas*. Further, as stated above, the Examiner's motivation for modifying Hori to *use a thin photoresist*, as recited in claims 1 and 8, is to *restrict the ionic species from being implanted into unwanted substrate regions*. However, these are the Examiner's subjective opinions, and are not supported by any objective evidence.

The Examiner has not shown why Hori should be modified to *use a photoresist layer from either the nature of the problem to be solved, the teaching of the prior art or the knowledge of persons of ordinary skill in the art. In re Rouffet*, 47 U.S.P.Q.2d. 1453,1458 (Fed. Cir. 1998). Further, the Examiner has not shown why Hori should be modified to *protect the desired surface of the substrate from the implantation beam from either the nature of the problem to be solved, the teaching of the prior art or the knowledge of persons of ordinary skill in the art. Id.* Further, the Examiner has not shown why Hori should be modified to *consistently implant the intended areas from either the nature of the problem to be solved, the teaching of the prior art or the knowledge of persons of ordinary skill in the art. Id.*

The Examiner must submit **objective evidence** and not rely on his own subjective opinion in support of modifying Hori to *use a photoresist layer. In re Lee*,

61 U.S.P.Q.2d 1430, 1434 (Fed. Cir. 2002). Further, the Examiner must submit **objective evidence** and not rely on his own subjective opinion in support of modifying Hori to *protect the desired surface of the substrate from the implantation beam. Id.* Further, the Examiner must submit **objective evidence** and not rely on his own subjective opinion in support of modifying Hori to *consistently implant the intended areas. Id.*

Therefore, the Examiner has not presented a *prima facie* case of obviousness for rejecting claims 1, 4-5, 7-8, 11-12 and 14. M.P.E.P. §2143.

B. Hori does not Teach or Suggest the Following Claim Limitations

Hori does not teach or suggest "providing a *thin photoresist layer*" as recited in claims 1 and 8. As stated above, the Examiner states that Hori fails to teach a photoresist layer. Paper no. 16, page 4; Paper no. 19, page 4. For at least the reasons stated above, the Examiner has not provided any **objective evidence** for modifying Hori to provide a photoresist layer. *In re Lee*, 61 U.S.P.Q.2d 1430, 1434 (Fed. Cir. 2002). Therefore, the Examiner has not presented a *prima facie* case of obviousness for rejecting claims 1 and 8. M.P.E.P. §2143.

Further, Hori does not teach or suggest "providing a thin photoresist layer to the semiconductor device that *covers a substantial amount of an active area comprising a source region and a drain region of the semiconductor device*" as recited in claims 1 and 8. The Examiner directs Appellants' attention to Figure 3 of Hori as teaching the above-cited claim limitation. Paper no. 19, page 4. Instead, Hori teaches:

> *Structures of the substrate 1 and the n^+ -type drain region 7b of the transistor* according to this example *will now be described in detail* referring to the drawings. FIG. 3 shows a computer simulation result of a two dimensional impurity profile near the drain region of the n-channel type MOS transistor, that is, a calculated profile of the

> concentration of boron ions. In the simulation using a computer, *an implant mask of an SiO_2 film is used instead of a $TiSi_2$ film.* As is shown in FIG. 3, the boron ions are implanted **only into a portion of the drain region** near the channel region (hereinafter called the "channel side") and do not affect the impurity concentration near the junction of the drain region. FIG. 4 shows a result of the simulation on a p-channel type (a surface channel type) transistor, that is, a calculated profile of the concentration of phosphorus ions. As is in FIG. 3, the phosphorus ions are selectively implanted into an edge portion on the channel side of the drain region. Column 7, lines 37-56.

Thus, Hori teaches using an implant mask of an SiO_2 over a portion of drain region 7b as illustrated in Figure 3. However, the *mask does not cover a substantial amount of an active area comprising a source region and a drain region.* Therefore, the Examiner has not presented a prima facie case of obviousness for rejecting claims 1 and 8. M.P.E.P. §2143.

Hori also does not teach or suggest "providing the halo implant to the semiconductor device, wherein the *thin photoresist layer* is used as a mask" as recited in claims 1 and 8. For the reasons as stated above, Hori does not teach or suggest a *photoresist layer.* Therefore, the Examiner has not presented a *prima facie* case of obviousness for rejecting claims 1 and 8.

Hori does not teach or suggest "wherein the photoresist layer comprises a *deep ultraviolet (DUV) layer*" as recited in claims 7 and 14. The Examiner states that "Hori et al. fails to teach mask comprising of a DUV photoresist." Paper no. 16, page 4; paper no. 19, page 4. The Examiner states:

> Hori et al. *fails to teach mask comprising of a DUV photoresist.* Applicant acknowledges that is well known in the art to use DUV photoresist to implant the halo region (see page 1, lines 6-12). Therefore, it would have been obvious in the art at the same time the invention was made to modify Hori et al. to include halo mask comprised of a DUV photoresist. *The ordinary artisan would have been motivated to modify Hori et al. in the manner described above for*

at least the purpose of protecting the desired surface of the substrate from the implantation beam. Paper no. 16, page 4; Paper No. 19, page 4.

As stated above, the Examiner must submit **objective evidence** and not rely on his own subjective opinion in support of modifying Hori to provide a photoresist layer comprising a deep ultraviolet layer. *In re Lee* at 1434. Further, as stated above, the Examiner must submit **objective evidence** and not rely on his own subjective opinion in support of modifying Hori to protect the desired surface of the substrate from the implantation beam. *Id.* Accordingly, the Examiner has not presented a *prima facie* case of obviousness for rejecting claims 7 and 14. M.P.E.P. §2143.

C. Conclusion

As a result of the foregoing, Appellants respectfully assert that since there are numerous claim limitations not taught or suggested in the cited prior art, the Examiner has not presented a *prima facie* case of obviousness for rejecting claims 1, 4-5, 7-8, 11-12 and 14 in view of the cited prior art. M.P.E.P. §2143.

It is noted that words are italicized only for emphasis. Words that are italicized are not meant to imply that only those words are not taught or suggested in the cited prior art.

IX. CONCLUSION

For the reasons noted above, the rejections of claims 1, 4-5, 7-8, 11-12 and 14 are in error. Appellants respectfully request reversal of the rejections and allowance of claims 1, 4-5, 7-8, 11-12 and 14.

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APPENDIX

1. A method for providing a halo implant to a semiconductor device comprising the steps of:

(a) providing a thin photoresist layer to the semiconductor device that covers a substantial amount of an active area comprising a source region and a drain region of the semiconductor device; and

(b) providing the halo implant to the semiconductor device, wherein the thin photoresist layer is used as a mask.

4. The method as recited in claim 1 wherein the halo implant is at approximately 45° angle.

5 The method of claim 1 which includes the step of providing a lightly doped drain implant before the halo implant providing step (b).

7. The method of claim 1 wherein the photoresist layer comprises a deep ultraviolet (DUV) layer.

8. A system for providing a halo implant to a semiconductor device comprising:

means for providing a think photoresist layer to the semiconductor device, wherein the thin photoresist layer covers a substantial amount of an active area comprising a source region and a drain region of the semiconductor device; and

means for providing the halo implant to the semiconductor device, wherein the thin photoresist layer is used as a mask.

11. The system as recited in claim 8 wherein the halo implant is at approximately 45° angle.

12. The system of claim 8 which includes the step of providing a lightly doped drain implant before the halo implant providing step (b).

14. The system of claim 8 wherein the photoresist layer comprises a deep ultraviolet (DUV) layer.

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